BULLETIN

OF THE

Society for the Promotion of Engineering Education

Vol. I | SEPTEMBER, 1910 | No. 2

EDITORIAL.

The Bulletin.—The Council has authorized the publication of the monthly BULLETIN for one year. Whether or not it will continue after that depends upon the action taken upon the report of the Program Committee which is to be made to the next annual meeting. During the year the Publication Committee will try to make the Bulletin meet the needs of the Society and the Committee will welcome suggestions at any time. In each issue there will be some space for current notes. For the first few months, however, the principal purpose will be to get before the members some of the convention material which should have full discussion. Members are urged to study the papers carefully and to contribute written discussion if they have anything of value to add. The papers printed this month certainly will arouse interesting discussion, which should be sent in promptly in order that it may be incorporated into the PROCEEDINGS.

The Membership Campaign.—In order that the BULLETIN may be a success it is necessary that the membership be enlarged. This can be done by co-operation. As an example,

take the case of Mr. Waddell, of Kansas City, who has been very active in this direction. He recently sent out personal invitations to about 120 friends and acquaintances. As a result the Secretary has received within a few days a large number of applications and they are coming in steadily. Mr. Waddell states that to be effective "every invitation must come from some personal friend or acquaintance, and must receive good, stiff endorsement." Some weeks ago the Secretary sent out a large number of forms for sending in names of possible members. These are now coming in and each person on these lists is being sent a personal letter signed by the Secretary. These letters may do some good, but nothing to what personal invitations will do. Every member is requested to lend a hand, particularly at this time. College work is opening up and teachers and others will be pleased to unite with an organization which means so much to technical education.

MEMBERSHIP LIST CORRECTIONS.

Since the membership list was printed in April the following changes have been reported to the Secretary.

Ayer, F. E. (omit house address); Bates, E. N. (58 Temple Court, Boston, Mass.); Bixby, W. H. (508 Colorado Bldg., Washington, D. C.); Brinsmade, R. B. (University of West Virginia; Burnham, R. (resigned); Farwell, E. S. (c/o Yellow Pine Paper Mill Co., Orange, Texas); Foss, F. E. (New York City instead of Pittsburgh); Foss, M. M. (omit house address); Frary, H. D. (c/o Carnegie Institution, The Ontario, Washington, D. C.); Gavett, G. I. (add Seattle, Wash.); Gay, R. W. (c/o Hunt and Hunt Co., Port Washington, N. Y.); George, N. R. (resigned); Green, J. A. (226 LaSalle St., Chicago, Ill.); Hancock, E. L. (Worcester, Mass., instead of Lafayette, Ind.); Haviland, E., Jr. (address unknown); Hawes, J. H. (74 Barnard St., instead of house address given); Hubbard, A. K. (Alva, Okla.); Hutton, S. E.

(until further notice Moscow, Ida.); Irish, L. W. (c/o State Dept. of Highways, Albany, N. Y.); King, R. S. (Gary, Ind.); Klein, A. W. (Asst. Professor instead of instructor); Kottcamp, J. P. (address unknown); Langsdorf, A. S. (add dean of Schools of Engineering); McShell, H. C. (should be Mitchell, H. C.); Munroe, G. E. (727 Brandywine St. instead of house address given); Myers, R. E. (resigned); Owens, R. B. (Sec. Franklin Institute, Phila., Pa.); Poorman, A. P. (Assistant professor in mechanical engineering, Purdue University, Lafayette, Ind.); Powell, E. H. (resigned); Pullen, M. W. (Onawa, Ia); Querbach, E. (510 Blackburn Ave., Sewickley, Pa.); Roe, J. W. (house no. is 84); Rogers, R. (7 Clinton St., Potsdam, N. Y.); Songe, A. (resigned); Whittemore, H. L. (Watertown Arsenal, Watertown, Mass.); Wrentmore, C. G. (resigned); Young, L. E. (name omitted in list), Director School of Mines, Missouri Univ., Rolla, Mo.

Important Correction.—The attention of members is called to a typographical error on p. xviii of the membership list. By the use of the asterisk instead of some other symbol before the name of Mr. Dudley, who died recently, it would appear that all members so starred had also died. The asterisk before a number of names simply means that the addresses are taken from the last membership list. For fear that Dr. Duncan's friends might be alarmed the correction was made by hand in the bound volumes and in many of the separate membership lists. The secretary explained the error to Dr. Duncan, who telegraphed "Make denial of my death very emphatic."

COLLEGE NEWS.

Colorado University.—Dean Ketchum who has, for the past year, been a member of the firm of Crocker and Ketchum, consulting engineers, will resume his work at the university this fall.—Mr. C. C. Williams has been appointed assistant professor of civil engineering.—Mr. F. W. Doolittle, former instructor in civil engineering, becomes assistant professor of mechanics in the University of Wisconsin.—Similarly Mr. G. I. Gay has been appointed instructor in civil engineering in the University of Illinois.—Professor H. S. Evans has spent the summer with the General Electric Co.

Illinois University.—Significant among the events of the past year has been the coming to the college of Dr. E. J. Berg as professor of electrical engineering in charge of the department and Mr. H. H. Stoek as professor of mining engineering in charge of the department. Professor Berg's enthusiasm and energy have had a tremendous influence in stimulating activities in the department of electrical engineering. Students and professors alike have shared in new experiences and have put forth stronger efforts. To Professor Stoek has fallen the difficult task of organizing a new department. While his students have been few, he came to his work at a time when the whole state was aroused to a condition of unusual interest because of problems presented in the coal-producing centers. His responsibilities at the university have been supplemented by those growing out of his membership in two state commissions, which have given him opportunities for shaping legislation and which will in the future make him a factor in the control of the state mine rescue stations which were authorized by the last Legislature. The college has installed for its railway engineering department a master car builders' drop testing machine and a master car builders' brake shoe testing machine, both of which have come into service during the year now closing. Through the generosity

of interested friends, a 100-kilowatt Curtis turbo-generator has been presented to the department of electrical engineering, although this machine is not yet installed. The addition to the power plant of the college which will provide a modern building with 1,000 boiler horse-power and which in effect will add to the facilities of the college of engineering, is now approaching completion.

Iowa University.—New shops covering about 13,000 square feet have been equipped this summer.—Dean Raymond's "Railroad Field Geometry" is in the press this summer.—The T. J. Goss prize of $100 offered for the best graduating thesis in engineering was awarded this year for an investigation of the relative strength of mortars. The conclusion reached was that a thin coating of silt, too thin to make the sand dirty, was the cause of the weaker mortar made with Iowa River sand as compared with standard sand.

Johns Hopkins University.—An interesting experiment is to be tried this fall in the holding of an Illuminating Engineering Institute. A number of prominent engineers will give lectures and presumably a large number of electrical engineering departments will be represented by delegates.

Kansas Agricultural College.—Professor A. A. Potter is now in charge of the mechanical engineering course.

Nebraska University.—The 1910 "Blue Print" contains an extensive illustrated description of the new mechanical engineering laboratories. There are also some other very interesting and useful articles, including some new data on reflected light by Professor G. H. Morse. The price of the "Blue Print" is 50 cents.

Purdue University.—The coming year will mark a rather radical change in the administration of the work in mechanical engineering at Purdue University for two reasons.—First, because of the construction of the new shops which will accommodate the department of practical mechanics, including drawing, descriptive geometry and shop work, leaving about double the present space for the engineering laboratories, which will be equipped during the summer for additional in-

struction in hydraulics, gas engineering, cement testing and heating and ventilation. The new shops will probably be as well equipped and designed as any in the country. Their removal from the present mechanical engineering building will permit very marked improvements in the mechanical laboratory work of the university. Second, it seemed advisable to offer some possibility of specialization in the senior year and short elective courses have been offered in heating and ventilating, railway mechanical, and gas engineering.

South Dakota State College.—Professor Brackett reports that the electrical course is being modified in such a way as to give the students first a general view of the subject, and then to take them over the same ground again in a more exacting way.

Southern California University.—Complete four-year courses have been opened for the first time this year. The enrollment is such as to promise well for the future, particularly in view of the interest in polytechnic high schools in Los Angeles and vicinity. The civil engineering course is directed by Professor C. W. Laurence and the electrical and mechanical engineering courses by Professor A. W. Nye.

Washington University.—Through the gift of $50,000 from Mr. Samuel Cupples, it has been possible to enlarge the laboratories by the addition of wood and iron shops with up-to-date equipment. On May 18, Professor G. O. James made a balloon ascension of 2,600 ft. in connection with his observations of Halley's comet.—Mr. E. O. Sweetzer has been promoted to an assistant professorship in civil engineering.

Wisconsin University.—The first annual banquet of the University Extension students was held at the Republican House, Milwaukee, June 6. The headquarters of the Division in Milwaukee are now at 211 Engineering Building.

A COLLEGE COURSE IN ELECTRIC WIRING.

Some years ago the writer had occasion to install some electric lamps and telephones in college buildings with the aid of student help and he found that the students took great interest in the work and that they were in much better position to understand the work in power station engineering than a class of equal ability which had not had any experience in electric wiring. Believing that a course in electric wiring would be very helpful as an introduction to electrical work, such a course was inaugurated at the State University of Iowa during the past year; it taking part of the time in the sophomore year formerly devoted to shop work.

The equipment for the course consists of the frame-work of a six-room cottage, erected in one of the laboratory rooms, and the ordinary wiring appliances for wiring by the knob and tube and fished systems. It is the intention to add metal moulding and conduit work next year. Use is made of the regular walls of the laboratory, which is in a frame building, for fishing wires under the exact conditions which will be found in the wiring of old buildings.

The method of procedure is to have recitations from a text on interior wiring, which includes the fire underwriter's rules, accompanying which the students draw plans of and take out the wiring put in by the previous class. After the material is sorted and put in the stock room wiring plans are given out and the house is wired anew; two or three men being assigned to a room. The wiring is completed; inspected by the instructor; switches, fixtures and meter installed and finally lamps and shades put in place, so that the completed job can be seen and an appreciation had of the small proportion of the work which is visible when a building is finished. The complete job includes the wiring and connection of an annunciator and a dining room buzzer; which, while com-

paratively simple, is a job that puzzles many electrical engineering graduates.

The objects of this course are: First to give the student some concrete electrical work early in the course which interests him in his chosen work in a way which it is impossible to accomplish by any amount of text-book or lecture work. Second, to show him work, which from its very nature, is concealed in the finished building and consequently can never be inspected in detail except during the progress of the building. Third, to give such a degree of manipulative skill that the student is in a position to get work along his chosen line during the summer vacation.

This course has been established for such a short time that it is impossible to tell whether the expectations will be fully met, but the prospects for its success are very bright. The students are much interested in the work and already several have signified their intention of trying to get wiring jobs during the summer.

It may be urged that the adding of another course to the curriculum is not permissible at the present time; but if we allow a place for shop work, this course may very well replace some of the time normally given to that subject by electrical engineering students.—A. H. FORD.

PROCEEDINGS.

MADISON MEETING.

JUNE 23 TO JUNE 25, 1910.

The eighteenth annual meeting of the Society for the Promotion of Engineering Education was held at the University of Wisconsin, Madison, Wisconsin, on Thursday, Friday and Saturday, June 23, 24 and 25, 1910. The sessions were held in the engineering building of the university.

THURSDAY, JUNE 23.

Morning Session.

The meeting was called to order at 10:00 a. m. by President Henry S. Munroe, professor of mining, Columbia University. The meeting was opened by an address of welcome from President Chas. R. Van Hise, of the University of Wisconsin. This address was responded to by President Munroe.

The report of the treasurer, Mr. Wm. O. Wiley, was read and accepted, and at the request of the Treasurer, an auditing committee was appointed. The report showed that the finances are in excellent condition. Professors E. R. Maurer and W. D. Pence were appointed as the members of this committee. The report of the Secretary, Professor Henry H. Norris, was read and accepted. The report emphasized the necessity for some means for keeping the members in touch during the year and outlined the plan for a monthly BULLETIN.

One hundred seven applicants for memberships, duly recommended by the Council, were elected.

President Munroe asked if any members desired to bring up any matters affecting the welfare of the Society. Mr. G. Harwood Frost responded by calling attention to the laxity of certain members in responding to requests from the officers. The remarks were prompted by a circular letter sent out by the Secretary on May 1, 1910. Mr. Frost remarked that "we get up a push once a year and then the momentum dies out in a very few months," and "it seems to me that engineering education is on trial before the intelligent citizens of the country." He outlined a number of matters which seemed to promise more effective work by the Society. These were:

1. An associate membership, to consist of students, formed into college auxiliary societies through the medium of professors and instructors already members of the Society.

2. The adoption of an official organ. The proposed BULLETIN might accomplish the purpose, or arrangments might be made with some existing paper which would devote some space to educational matters, mentioning the Society in connection with these.

3. The appointment of a permanent committee on publicity and publication to look after the general interests of the Society, to make its existence known, to keep it before the attention of engineers, and in general to champion the cause of technical education. A member of this committee should be a permanent employee of the Society. As the expense of this enlarged work should be greater than the facilities of the Society will at present allow, it is suggested that the desirability of assisting in the work be brought to the attention of men of wealth who might be inclined to assist. Mr. Frost suggested that more consideration be given to the non-teaching engineers in the membership. In conclusion he moved as follows: "That the President appoint at this meeting a special committee of five to consider ways and means of extending the welfare and usefulness of the Society, and that the recommendations of this committee be presented for open discussion by the members at this convention before being finally

referred to the Executive Committee for action." This motion was fully discussed and it was finally passed unanimously.

In the discussion of Mr. Frost's suggestions the Treasurer pointed out that the condition of the Society is not such as to give any cause for discouragement. "If any business man would make as good progress in three years as this Society has done he would be very well satisfied. In three years the membership has increased seventy per cent. Instead of being nearly a year behind in our payments, we have, by careful expenditure, paid up all debts."

Professor H. Wade Hibbard pointed out that it is essential for the Society to keep in close touch with the practicing engineers in the professions, in order that they may correctly appreciate the work of the technical schools. He intimated that there is great danger that a wrong impression regarding the value of this work may become prevalent.

Professor W. S. Franklin brought up the matter of interesting young men in becoming teachers of engineering subjects. He indicated that there is increasing difficulty in securing good teaching material. He thought that the Society might do something to help in the desired direction.

President Munroe then announced as the Committee on the Welfare of the Society: Mr. G. H. Frost, chairman, Dean Goss, Dean Raymond, Dean Turneaure and Mr. Wiley.

After the executive session just described the following papers were presented by their respective authors:

"Inspection Trips for Technical Students," by Professor G. C. Shaad,

"The Teaching of Judgment," by Mr. E. J. Kunze, and

"Notes on German Technical Universities," by Dean G. H. Shepard.

Afternoon Session.

The first matter taken up was the report of the Committee on Entrance Requirements. This report had been printed in pamphlet form and distributed five weeks before the meeting. After considerable discussion the following motion was passed:

"That the report be referred back to the committee with the request that the committee collect opinions and present their definite recommendations at the next meeting."

The Society then adjourned from the engineering building to the law building, on account of the heat, and proceeded to a consideration of the report of the Committee on Engineering Degrees. This report had been distributed by mail in printed form a few days in advance of the meeting. The report was *accepted* and the Society then proceeded to discussion regarding the *adoption* of the committee's recommendations. The first recommendation was adopted after some discussion. Final action on the remaining paragraphs was postponed to Friday morning after the recommendations had been amended by the addition of the words "in engineering" after "Bachelor of Science" in Recommendations II, III, IV and V.

Professors W. D. Pence, J. G. D. Mack and C. P. Burgess then presented a symposium of brief papers entitled "Co-operative Work for the Wisconsin Railroad and Tax Commissions." The divisions of the symposium were: (A) Historical and Descriptive, Professor Pence; (B) Mechanical Features, Professor Mack; (C) Gas and Electric Service, Professor Burgess. The papers were illustrated by exhibits of charts and forms used in the work of the commission.

Evening Session.

This session was taken up with a discussion on the improvement of mathematical instruction. President Munroe had sent out a circular letter asking specific questions, particularly regarding the teaching of calculus. The President announced that the report of the Committee on the Teaching of Mathematics to Engineering Students would be distributed in galley form, and that no attempt would be made to discuss this report at the present time. (As shown by the Council minutes this report will be distributed to the membership, and will be made a special order for the 1911 meeting.)

The President then took up, one at a time, the questions of

the symposium letter and after reading written contributions, called for oral ones. A very interesting discussion resulted, showing that the topic is a live one.

After the discussion the President announced as the Committee on Resolutions for this meeting, Dean C. R. Richards and Professors A. H. Ford and A. J. Wood.

FRIDAY, JUNE 24.

Morning Session.

President Munroe delivered his presidential address on "Efficiency on Engineering Education" by way of opening the symposium on that subject. A circular letter, similar in plan to that already described in connection with the symposium on mathematics, had been sent to the membership, and a large number of written replies had been received. These were read in connection with the oral discussion, which was very full.

Professor W. T. Magruder presented his paper on "Inspection Trips of Ohio State University Students." In preparation for this paper copies of a booklet, describing the 1910 tour, had been distributed to the members several weeks in advance of the meeting. An interesting discussion followed the presentation of the paper.

After the discussion a number of business matters were taken up and disposed of as follows:

The report of the Committee on the Welfare of the Society was presented as follows:

"The special committee appointed at the general session to consider suggestions regarding the welfare of the Society begs to report that in its belief the publication of the proposed BULLETIN will constitute as great an advance as is possible for the Society to undertake at this time, and recommends that this BULLETIN be published.

(Signed)

G. HARWOOD FROST,
Chairman.

It was announced that the matter of publishing a BULLETIN had been referred by the Council to the Program Committee with instructions to study the plan, to make an estimate of the cost, to consider the advantages and disadvantages, and the possibility of continuing the publication, and to submit a report to the Council which is to take a letter ballot on the subject. The Council requested power to act in this matter and this was granted by the Society on motion.

A letter from the director of the Carnegie Technical Schools, inviting the Society to meet at Pittsburgh next year, was presented. The matter was referred to the Council with power and the Society passed a unanimous vote approving Pittsburgh as the next meeting place.

The President announced the receipt of galley proofs of the report of the Committee on the Teaching of Mathematics to Engineering Students. He stated that this report will be distributed, and that the members are requested to send written communications for publication regarding it, so that when the report is finally printed it shall, as nearly as possible, represent the views of the Society.

The report of the Committee on Engineering Degrees, which had been made a special order for this session, was then taken up. At the request of President Howe, President Munroe ruled that the report is amended by the insertion of the words "Doctor of Philosophy" in recommendation V of the report. The recommendation as amended reads, "The degrees of doctor of philosophy, doctor of science and doctor of engineering should be given, etc." In the discussion Mr. William Kent brought up the question of the general treatment of committee reports. He made the same recommendation as he had previously done to the Council and, as the Council had ordered a report on the subject from the Program Committee, no action was taken by the general meeting on Mr. Kent's suggestion. After full discussion the report of the committee was approved. Although no definite motion was made, it is understood that the committee is discharged. Dean Goss called attention to a reference, in Paragraph II of the report,

to certain data concerning entrance requirements which had been collected by the committee. By motion this material was referred for disposition to the Executive Committee of the Society.

SATURDAY, JUNE 25.

Morning Session.

Vice-president A. N. Talbot presided in the absence of President Munroe.

Dean Herman Schneider, of the University of Cincinnati, presented his paper on "Recent Progress in Co-operative Technical Education." This was discussed at considerable length.

Dean J. J. Clark, of the International Correspondence Schools, then read a paper on "Clearness and Accuracy in Composition." This paper was also fully discussed.

In the absence of the author, Professor Diemer read Dean J. P. Jackson's paper on "Character Training," after which Professor G. R. Chatburn discussed the subject of "Student Delinquency."

The Secretary then read by title the following papers: "Teaching Electrical Engineering to Non-electrical Engineers," by Professor C. Francis Harding, of Purdue University; "Technical Education in Germany," by Mr. Frank Koester, consulting engineer; "Technical Education in China," by Professor W. H. Adams, Pei Yang University, Tientsin, China; "System and Efficiency in Technical Instruction," by Professor C. C. Slocum, University of Cincinnati.

The Secretary reported that the very complete revised report of the Committee on Technical Books for Libraries had been submitted to the Council, and that the Council recommends that the committee be discharged with thanks for the very great amount of labor which they have put upon the report. This action was taken by the meeting, and the report was referred with power to the Publication Committee.

The Auditing Committee then presented the following report:

Your committee appointed to audit the accounts of the Treasurer for the past year respectfully report that they have examined the accounts and vouchers of the Treasurer, and have found them to be correct as reported.

Signed, E. R. MAURER,
W. D. PENCE,
Committee.

The report of the Committee on Resolutions was then read as follows:

RESOLUTIONS.

"The members of the Society for the Promotion of Engineering Education, present at the Madison meeting, 1910, are deeply appreciative of the many courtesies extended to them by the president and regents of the university and by the dean and faculty of the college of engineering.

We cannot enumerate all of the pleasures and privileges which it has been our part to enjoy. It is fitting, however, that we spread on the records of this Society, recognition of the use of Chadbourne Hall, opened for our convenience; for guidance through the several buildings; for boat and automobile rides; for luncheons and entertainments. Also our gratitude is due to the Maple Bluff Golf Club, which gave us an afternoon and evening away from the heat and routine; to the Madison Commercial Club and citizens for contributions for the entertainment of the Society; and to President Van Hise, for his able talk on a most important subject of national significance. Nothing has been left undone that might make the stay of the ladies of the convention one long to be remembered.

To many of us the magnitude of the work of this, the greatest of our state universities, has been a revelation. The pioneer work in the Division of Extension, which in three years has attained a registration of 3,200 students, most of whom are taking work having a direct bearing on the industries of the state, has given us a broader conception of the functions of a state institution.

For the courtesies enumerated and many others we beg to thank the university and especially its engineering faculty.

Signed, C. R. RICHARDS,
A. H. FORD,
A. J. WOOD,
Committee.

The report of the Nominating Committee was presented and on motion was accepted, and the Secretary was instructed to cast the affirmative ballot of the Society for the names proposed. The report is as follows: "The Nominating Committee presents to the Society for its consideration the following names for the several official positions to be filled.

For President: Professor Arthur N. Talbot, University of Illinois,

For Vice-presidents: Mr. William Kent, Montclair, N. J., and Dean Milo S. Ketchum, University of Colorado,

For Secretary: Professor Henry H. Norris, Cornell University,

For Treasurer: Mr. William O. Wiley, New York City,

For Members of Council, term to expire 1913: Dean Charles H. Benjamin, Purdue University; Dean George W. Bissell, Michigan Agricultural College; Professor E. E. Brydone-Jack, University of Manitoba; Professor William H. P. Creighton, Tulane University; Director John F. Hayford, Northwestern University; Dean Charles R. Richards, University of Nebraska; Professor Harry W. Tyler, Massachusetts Institute of Technology.

Signed, MANSFIELD MERRIMAN,
Chairman,
by WILLIAM E. RAYMOND,
Secretary.

After accepting the report of the Nominating Committee the meeting adjourned.

Special Features of the Convention.

Friday afternoon and evening were devoted to the non-technical part of the program. At noon the ladies were entertained at luncheon by Mrs. F. E. Turneaure, after which an informal reception was held. During the early part of the afternoon the men inspected the buildings of the University and the State Library and Historical Museum. The new government Forest Products Laboratory was a center of great interest. Later in the afternoon, the ladies went in automobiles for a delightful drive about the country, joining the men, who went by boat, at the Golf Club. Here a supper was served by the local committee and afterward, with his audience grouped about him in the open air, President Charles R. Van Hise delivered an informal address on the "Conservation of our National Resources." The delightful afternoon and evening ended by a boat ride on Lake Mendota which brought the party to the landing at the university gymnasium.

In addition to the more formal entertainment, numerous other informal and smaller gatherings were held, and altogether the social side of the meeting was considered one of its most successful, as well as most attractive, aspects.

Attendance at the Convention.

One hundred and fifty-one persons registered at the Madison meeting, which was a gain over the attendance at the New York meeting, where 116 were registered. The gratifying attendance indicated the great interest in the Society taken by the members in the middle West. Thirty of those in attendance were present at the New York meeting. Thirteen were charter members of the Society: I. O. Baker, C. L. Crandall, H. T. Eddy, F. E. Giesecke, W. F. M. Goss, O. P. Hood, W. T. Magruder, Mansfield Merriman, H. S. Munroe, W. G. Raymond, L. E. Reber, A. N. Talbot, J. A. L. Waddell.

The list of men attending the meeting is as follows: Warren Babcock, I. O. Baker, W. C. Bauer, M. C. Beebe, Edward Bennett, O. C. Berry, G. W. Bissell, H. S. Bitting, B. B.

Brackett, W. E. Brooke, C. F. Burgess, C. H. Burnside, E. F. Chandler, G. R. Chatburn, J. J. Clark, H. E. Cobb, L. E. Conrad, R. T. Craigo, C. L. Crandall, C. H. Crouch, N. P. Curtis, E. W. Davis, G. J. Davis, Jr., J. C. Davis, Hugo Diemer, C. E. Downton, F. O. Dufour, W. V. Dunkin, H. T. Eddy, F. L. Emory, M. I. Evinger, E. J. Fermier, F. A. Fish, James Fisher, Jr., A. H. Ford, M. M. Foss, W. S. Franklin, E. H. Freeman, G. H. Frost, A. H. Fuller, L. E. Garrett, F. E. Giesecke, J. H. Gill, J. H. Gormley, W. F. M. Goss, H. W. Gray, M. R. Hammer, D. F. Harza, J. F. Hayford, A. E. Haynes, E. R. Hedrick, H. W. Hibbard, C. R. Hixon, E. C. Holden, O. P. Hood, C. S. Howe, J. H. Hunt, A. L. Hyde, E. S. Johonnott, W. H. Kavanaugh, E. B. Kay, O. D. Kellogg, William Kent, A. M. Kenyon, R. McA. Keown, M. S. Ketchum, W. H. Kirchner, E. J. Kunze, J. H. Leete, E. A. Loew, L. W. Jones, O. A. Leutwiler, F. M. McCullough, F. W. McNair, A. L. McRae, J. G. D. Mack, W. T. Magruder, C. W. Malcolm, J. V. Martenis, E. R. Maurer, D. W. Mead, W. H. Meeker, C. E. Mendenhall, Mansfield Merriman, B. Mitchell, H. F. Moore, A. W. Mosely, W. E. Mott, H. S. Munroe, F. H. Murphy, D. A. Murray, H. H. Norris, A. R. Nottingham, H. D. Orth, J. I. Parcel, L. G. Parker, W. D. Pence, J. D. Phillips, A. A. Potter, F. N. Raymond, W. G. Raymond, L. E. Reber, E. W. Rettger, C. R. Richards, Herman Schneider, W. H. Schuerman, G. C. Shaad, Adolph Shane, E. M. Shealy, F. C. Shenehon, G. H. Shepard, S. C. Shipley, J. W. Shuster, A. G. Smith, W. B. Stelzner, A. N. Talbot, S. N. Taylor, J. M. Telleen, J. A. Thaler, A. L. Thomas, C. C. Thomas, H. J. Thorkelson, F. E. Turneaure, C. R. Van Hise, J. A. L. Waddell, K. B. Ward, J. W. Watson, J. M. White, W. O. Wiley, V. T. Wilson, M. O. Withey, A. J. Wood, L. E. Young, O. B. Zimmerman, Alexander Ziwet.

The following ladies were also in attendance: Mrs. Baker, Mrs. Bent, Mrs. Bissell, Mrs. Brackett, Mrs. Fish and daughter, Mrs. Kay, Mrs. Ketchum, Miss McNair, Mrs. Merriman, Mrs. Murphy, Mrs. Norris, Mrs. Stelzner, Mrs. Waddell.

Secretary's Report, 1909–1910.

To the Society for the Promotion of Engineering Education:

The Secretary has devoted his attention this year to plans for increasing the membership, and for keeping the membership in closer touch during the year. The central feature of the former stimulation of interest in the various educational and other centers. Through the co-operation of the members, we have received during the year 130 applications which have been acted upon either by letter ballot or at this meeting.

The net membership at this time is 848, making an apparent gain for the year of 89. The real gain is considerably greater than this, because, of the 41 names removed from the roll, there are quite a number of those persons who claim to have resigned years ago. This number of withdrawals seems excessive, but does not represent an excessive number of resignations received during the current year. It is hoped that some of these names may be restored to the active list during the coming year. It is interesting to note that of the original 71 members there are at present 40 on the active list.

Applications have come mostly from teachers only because little attention has been directed to practicing engineers this year. More attention should, during the coming year, be given to non-teaching engineers because large numbers of these would enroll if invited. They would not only help the Society, but they would enjoy its benefit. The membership campaign was greatly assisted by the use of a little booklet entitled "Why Join the Society for the Promotion of Engineering Education?" A large edition of this was printed, of which 1,000 copies have been reserved for use during the coming year. A very fair proportion of applicants during the past year have been teachers of subjects allied to engineering, particularly mathematics. The Secretary suggests that teachers of physics be approached during the coming year.

A great deal of time has been spent in preparation for future activities of the Society, particularly to preliminary work on the proposed monthly Bulletin. After considerable

correspondence during the year the Executive Committee authorized the issuing of a sample number which was duly prepared and distributed. Unfortunately, this sample number was incomplete, but it demonstrated that some advertising support can be secured and it showed the members, in a general way, what the Secretary had in mind. The income from advertising from this number was $92 and the expense for printing was $99. The sum of $16 in addition was spent for mailing, but a large part of this will be returned if the BULLETIN is admitted to second-class rates. In addition to the BULLETIN a large amount of other printed matter was distributed during the year for the purpose of keeping the membership in active touch with the officers of the Society.

In order that the Society may perform its functions more efficiently it is suggested that the members organize informally in different centers for the discussion of papers and of topics having relation to engineering education.

Respectfully submitted,

HENRY H. NORRIS,
Secretary.

TREASURER'S REPORT, 1909–1910.

To the Society for the Promotion of Engineering Education:

The Treasurer would respectfully report the condition of the Society's finances as follows:

SUMMARY OF RECEIPTS.

June 21, 1909, Cash balance on hand	$ 818.90
Juyl 6, 1909, to June 16, 1910,	
Received for 1910–1911 dues	60.00
Received for 1909–1910 dues	2,204.05
Received for dues prior to 1909–1910	193.69
Received from sales of volumes of Proceedings	295.00
Received for authors' reprints	28.90
Received for expenses of entertaining New York meeting	256.50
Received interest at bank, July 1, 1909, January 1, 1910	16.51
	$3,873.55

SUMMARY OF EXPENDITURES.

Entertainment of New York meeting	$ 285.54
Programs and badges for New York meeting	40.75
Reporting New York meeting	208.25
Expenses of Treasurer for printing, postage, etc., including stationery for other officers, and clerical assistance	210.34
Expenses of Secretary for printing, postage and clerical assistance (including expenses campaign for new members)	403.09
Secretary's honorarium	250.00
The New Era Printing Company,	
For Vol. XVI	795.22
For lists of members, authors' reprints, expressage, etc., for last year	305.38
For Vol. XVII	670.65
For lists of members, etc., as above	290.56
Poates Engraving Company, cuts for Vol. XVII	21.00
Stanley Photo Company, cuts for report on mathematics	14.17
Advance printing for the Madison meeting	36.40
Cash on hand, June 17, 1910	342.20
	$3,873.55

ASSETS.

Cash on hand, June 17, 1910	$ 342.20
Due from members and non-members	669.62
Value of 2,823 volumes of Proceedings (approx.) at $1.00 each	2,823.00
	$3,834.82

LIABILITIES.

Due for sundries	$ 30.77
Due A. L. Williston for commissions on sale of Proceedings and balance of honorarium	275.24
Net assets	3,528.81
	$3,834.82

The total amount due the Society is $669.62 as compared with $521.53 last year. There are 68 members one year in arrears; 26, two years; 14, three years, and 1, four years. The total arrearage in membership-years is $(68 \times 1) + (26 \times 2) + (14 \times 3) + (1 \times 4) = 166$. The corresponding number last year was 155.

The Society is to be congratulated upon having paid up

back bills and upon being, at the present time, on a strictly cash basis.

Respectfully submitted

WILLIAM O. WILEY,

Treasurer.

The following applicants were admitted to the Society between July 1, 1909 and July 1, 1910:

Elected by letter ballot, December 15, 1909: D. F. Adams, Edward Bennett, M. R. Bowerman, H. H. Dalaker, R. F. Deimel, F. A. DeLay, J. W. Dorsey, M. I. Evinger, C. W. Hudson, J. W. Kidd, J. Luderitz, R. M. Mark, J. A. Mease, H. Miller, R. E. Noyes, M. H. Peck, M. W. Pullen, H. E. Satterfield, F. C. Shenehoy, D. O. Stone, H. J. Thorkelson, C. C. Williams. (23.)

Elected by the Society at the Madison Meeting: A. H. Anderson, William Anderson, James Aston, H. T. R. Aude, E. E. Bankson, W. N. Barnard, R. M. Barton, W. C. Bauer, E. J. Berg, W. J. Berry, H. C. Bickford, Ernest Blaker, G. E. Bray, R. B. Brinsmade, C. H. Burnside, F. E. Burpee, J. A. Bursley, W. H. Butts, J. W. Calnan, H. D. Carpenter, R. C. Carpenter, M. P. Cleghorn, H. C. Coffeen, W. R. Cornell, C. I. Corp, E. E. F. Creighton, R. E. Danforth, Joseph Daniels, N. F. Davis, C. S. Dearborn, G. F. Eckhard, C. L. Eddy, W. T. Ellis, D. D. Ewing, A. E. Flowers, L. E. Garrett, J. Z. George, J. E. Gramlish, H. W. Gray, C. A. Green, C. I. Gunness, E. H. Hall, J. O. Hamilton, F. C. Harris, E. R. Hedrick, W. A. Hillebrand, C. R. Hixon, F. W. Ives, J. H. James, R. R. Keely, O. D. Kellogg, W. A. Kennedy, R. M. Keown, E. W. Kerr, W. H. Kirchner, E. E. Lawton, Barry MacNutt, F. M. McCullough, R. Matthews, Brainerd Mitchell, Jr., F. H. Murphy, D. A. Murray, J. H. Nelson, A. E. Norton, A. R. Nottingham, H. D. Orth, R. S. Owen, J. I. Parcel, R. L. Parshall, Thomas Pilkington, R. J. Potts, J. S. Pray, F. N. Raymond, H. P. Rees, E. W. Rettger, T. E. Richards, W. H. Richards, Milnor Roberts, J. E. Root, L. D. Rowell, F. B. Rowley, S. L. Ruggles, W. C. Sabine, H. L. Seward, F. R.

Sharpe, G. H. Shepard, F. H. Sibley, T. L. Smith, Jr., J. H. Smith, W. D. Stearns, C. P. Steinmetz, K. D. Swartzel, W. J. Sweetser, J. H. Tanner, A. N. Topping, W. L. Upson, C. B. Veal, W. R. Veazey, C. W. Waggoner, E. S. Walker, J. W. Watson, J. B. Whitmore, A. H. Willett, M. O. Withey, E. H. Wood, O. S. Zelner, S. J. Zowski-Zwierzchowski. (107.)

The sources of the 1909–1910 applications were as follows: Alabama Polytechnic 1, Alabama University 1, Arkansas University 1, Armour Institute 2, Brooklyn Polytechnic Institute 3, Brown University 2, Bucknell University 1, Carnegie Technical Schools 4, Case School 5, Cincinnati University 1, Clarkson School 2, Colorado Agricultural College 2, Colorado University 1, Columbia University 1, Cornell University 10, Dartmouth College 1, Denison University 1, Engineering firms 4, Escola de Engenharia (Porto Alegre, Brazil) 1, Florida University 1, Harvard University 4, Highland Park College 1, Illinois University 1, Instuto Technico Professional (Porto Alegre, Brazil) 1, Iowa State College 4, James Miliken University 1, Kansas State College 5, Kansas University 2, Lehigh University 2, Louisiana University 1, McGill University 2, Michigan College of Mines 2, Michigan University 3, Minnesota University 7, Mississippii University 1, Missouri School of Mines 1, Missouri University 3, Montana State College 1, North Carolina Agricultural College 2, North Dakota Agricultural College 1, Northwestern University 1, Nova Scotia Technical College 1, Ohio Northern University 1, Ohio State University 2, Pei Yang University (Tientsin, China) 1, Pennsylvania State College 3, Pittsburgh University 2, Pratt Institute 2, Purdue University 2, Stanford University 1, Stevens Institute 1, Syracuse University 2, Texas A. and M. College 2, Union University 3, Washington State University 1, West Virginia University 2, Wisconsin University 11, Worcester Polytechnic Institute 1, Yale University 1. Total 130.

The above minutes are respectfully submitted to the Society.

HENRY H. NORRIS,
Secretary.

MINUTES OF THE COUNCIL.

The Council held three sessions during the Madison meeting. In accordance with a resolution adopted by the Council the minutes were ordered published in the annual volumes of PROCEEDINGS hereafter.

First Session, June 23.

The meeting was called to order at 9:00 A. M. by President Munroe. A list of applicants was presented and acted upon in two sections, teachers and practicing engineers.

The Council authorized a change in the form of printing the membership list by which the bulk can be considerably reduced. A printed page showing the proposed form had been distributed in advance.

The Council directed that, in future, the membership list be omitted from the annual volumes of PROCEEDINGS.

The Council then took up the matter of publishing a monthly BULLETIN as suggested by the Secretary. A sample number of the proposed BULLETIN had been printed and distributed to the membership. Action was deferred to a later meeting.

A suggestion was received from Professor J. M. White that a Committee on Buildings for Engineering Colleges be appointed. The Council recommended that a paper be secured from Professor White on this subject for the next meeting.

Second Session, June 24.

The meeting was called to order at 9:00 A. M. with President Munroe in the chair.

The matter of publishing a monthly BULLETIN was referred to the Program Committee for report which shall be acted upon by letter ballot by the Council. The Council instructed that a preliminary report be made to the general session at this convention.

By motion the Council directed that the matter of increasing the Secretary's honorarium and the expenses of the Secretary's office be referred to the Program Committee to be considered with the BULLETIN.

An invitation from the publishers of the American year book, requesting the Society to join the project was referred to the Program Committee with power.

An invitation from the Carnegie Technical Schools to hold the next meeting at that institution was received, ordered spread upon the minutes, and referred to the incoming Council for consideration.

The Council referred to the Program Committee for report to a subsequent meeting of the Council, Mr. Kent's suggestion "that the Council recommend to the Society at large that reports of committees be received and printed in the PROCEEDINGS *as the reports of committees;* that these be referred back to the committees for such revision as they choose to make after hearing the discussion; that the committees then be discharged by resolution; and that the Society at large do not adopt reports.

The Council by motion directed that the report of the Committee in the Teaching of Mathematics to Engineering Students be received and printed and that it be made a special order for the next meeting.

Third Session, June 25.

The meeting was called to order at 8:30 A. M. with Professor Mansfield Merriman in the chair.

The revised report of the Committee on Technical Books for Libraries was presented and referred to the Publication Committee with power. The Secretary read a letter from Professor Ford, chairman of the first-named committee, explaining what his committee had done in the way of revision. The Council further passed the following motion: "That this Council recommend to the Society that the Committee be discharged with the thanks of the Society."

(Vice-president Talbot then took the chair.

At the suggestion of the Secretary a motion was passed discontinuing the practice of paying the Secretary a commission on the sale of volumes of PROCEEDINGS.

The Council authorized the Secretary to cast an affirmative

ballot for the Council recommending to the Society for election all applicants whose applications are presented before the close of the meeting, suitably endorsed or for which suitable endorsements are secured within a reasonable period.

Dean Raymond raised the question of censorship of papers submitted to the Society, and after discussion the following motion was passed: "That this matter be referred for consideration for the formulation of a by-law, if desirable, to the Program Committee, who shall consider the question and if a change should be made, shall propose a by-law in regular form."

The Council passed a motion that hereafter the minutes of the Council meetings shall be printed in the PROCEEDINGS so that the members generally shall know what is done at these meetings.

This session closed the work of the 1909–1910 Council.

Respectfully submitted,

HENRY H. NORRIS,
Secretary.

If errors in the minutes of the Madison meeting are brought to the attention of the Secretary at once the minutes will be corrected before they are printed in the PROCEEDINGS.

ADDRESS OF WELCOME.

ON BEHALF OF THE UNIVERSITY OF WISCONSIN.

BY PRESIDENT CHARLES R. VAN HISE,
of the University.

Mr. President and members of the Society for the Promotion of Engineering Education: It is a very great pleasure indeed for me, on behalf of the University, to welcome you as our guests. During your stay here everything we have is at your service, including a sufficient amount of warmth to keep you comfortable. We hope and believe that the warmth of hospitality of the members of the engineering faculty will be equal to that of the atmosphere.

I have been deeply interested in the work of the Society for the Promotion of Engineering Education, although I have not been able to attend its meetings. In looking over the PROCEEDINGS I have noted with great satisfaction the emphasis that is now being put upon education in subjects other than engineering, in the training of the engineer. It seems to me that the realization by the teachers of engineering that an education which is technical throughout is not adequate, is the most important new conception that has appeared in engineering education in recent years. More and more it is being demanded of an engineer that he shall not simply be a technical man, but that he shall be a speaker; that he shall be a writer; that he shall know the relation of his subject to law and political science; that he shall be able to handle his subjects commercially; in short, that he shall be able to be a man among men in reference to leadership in all lines which engineering practice touches in our modern civilization. This new conception of the engineer demands that there shall be a much broader and higher training for him than was given by the schools of technology when they were first organized.

Recently the Association of State Universities and the Association of American Universities have set a standard for universities. This is not a standard which is required of all the membership, but a standard which is desired as a goal. The standard is that the professional schools shall require, as a condition for admission, two years of work in liberal arts or their equivalent. It has decided that the divisions of a university which have this requirement shall be called "schools." Thus we have the "schools of medicine" and the "schools of law," which at the present time do require two years of work in liberal arts or their equivalent for admission to the professional work, so far as the best universities are concerned.

I believe that this is the minimum development towards which we should look in the near future. I do not advocate that at the present moment we should publish among our entrance requirements that no students shall be admitted to the colleges of engineering who have not this attainment. I do believe, however, that we can set a date when the first of these years shall be required, and another date, perhaps two or three years later, when the second year may be required. At the present moment I believe it is possible, if the chief colleges of engineering will get together, to say that two years from next autumn, one year of liberal arts shall be required for admission to the college of engineering, and that two years from next autumn, two years shall be required. Your registration will not be greatly increased thereby and it may be that the numbers of students will not increase as rapidly as at present. Higher standards, however, always justify themselves, and I hope, therefore, that this Society may consider the question of a formal advance to the standard which has been set for the other learned professions, and place engineering, as a profession, on a par with law and medicine.

Probably in connection with this movement it will be necessary to provide also for technical education of a lower grade. That is a problem which should be correlative, to be considered with this problem which I have suggested. I shall not venture any suggestions in reference to the lower grade of

technical education as I have not yet given it sufficient consideration.

Believing that it is more important to produce many men of culture who are engineers in the broadest and highest sense than to produce many technologists, I welcomed the formation of this Society. I believe it will be an increasingly important instrument in reaching a higher plane in technical education. I therefore welcome you to the University of Wisconsin in order that you may carry forward this work of the better development of engineering education.

RESPONSE.

(ON BEHALF OF THE SOCIETY.)

BY PROFESSOR HENRY S. MUNROE,
President of the Society.

Mr. President, Gentlemen of the University: On behalf of the Society it is my pleasant duty to accept your warm and hearty greeting. It was a happy idea of Dean Turneaure to suggest this university for our meeting place. Those of us who are in the older endowed institutions of the East are glad of the opportunity to visit one of the great state universities which are becoming such formidable, although friendly, rivals. We are all working for a common purpose and there is work enough for all. The field is large enough for almost unlimited growth of all without danger of harm to the best interests and the fullest development of any. Those of us who come from other state universities welcome the opportunity of coming to this institution which is working out so many problems which are common to all, which is developing new fields of academic usefulness, and which is finding new bonds of knowledge and interest between the university and the state. As in the middle ages the noblemen and the commons united in building great cathedrals for the glory of God and the nation, so in this nation the rich and poor are uniting in building great universities. As the very existence of civilization depended upon the existence of the church in the past, so we also owe much to the university in the development of civilization at the present time. Both church and university are representatives of the scholarly life, and each contributes its share to the common end.

Mr. President, we are all watching with interest the work of your university, which is doing a noble service in pointing out new ways in which the scholar may serve the state, from which the university may in time become a new factor in our state existence, sharing with the legislative, the executive and the judiciary the work of the state.

The following paper was presented at the eighteenth annual meeting, Madison, Wis., June 23, 24, 25, 1910. Written discussion is invited.

ENGINEERING EDUCATION IN GERMANY.

BY FRANK KOESTER,

Consulting Engineer.

After the great struggle from which the German States gained their independence, at the termination of the Napoleonic War in 1815, the economical conditions of Germany had reached the lowest ebb. At that time the German States had but a small population left owing to the undeveloped state of commercial industries and the devastation due to this long struggle. In England, at that time, the steam-engine had begun its triumphal progress and opened up this country's richness in iron and coal.

It was recognized in Germany that the country could only be lifted economically through the expansion of industrial activity. Two ways led to this end; the practical way, taken by pioneers like Krupp, Borsig and Siemens, working quietly and uninterruptedly to replace the former state of handicraft by organized industry; and the theoretical way, adopted by the government, of placing industry on a scientific basis by the establishment of technical schools. That permanent progress in competition with other countries could only be built up satisfactorily on such a foundation is proven by the recent developments in technical chemistry and electricity, as well as in heat-engines and in engineering in general.

The beginning of the German technical schools dates back to the middle of the nineteenth century. Nearly all of the technical colleges originated, however, from the so-called Mittel-Schulen (intermediate schools), and only after they had by continuous effort obtained a high standing did they obtain charters as Technische Hoch-Schulen (technical universities). As an example, the Berlin Technical University was formed

by the union of the Architectural School, founded in 1779, and the Commercial Academy or Trade School, founded in 1821.

The aim of the technical university is expressed in the first paragraph of the constitution of the Berlin Technical University, which reads as follows: "The aim of the technical university is to furnish a means for higher education for the technical professions, in civil and industrial service and in commercial undertakings, as well as to cultivate the arts and sciences so far as they come under the head of technical instruction." Every technical university has departments for separate studies, and in each are divisions for architecture; civil, mechanical and electrical engineering; chemistry; metallurgy and mining; natural sciences and mathematics. There are some of these universities which have special departments, as electro-chemistry, marine engineering and aërial navigation, forestry, agriculture, etc.

The great development of technology made necessary the opening of a great number of new courses in all the technical schools. The most recent new course is that in aërial navigation, thus helping to make a positive science of this means of transportation.

Germany at present has eleven universities, established and chartered as technical universities as given below.

Name.	Established.	Chartered as Universities.
Berlin	1799	1799
Stuttgart	1829	1862
Dresden	1828	1851
Carlsruhe	1825	1865
Darmstadt	1836	1868
Aix la Chapelle	1870	1870
Brunswick	1745	1877
Munich	1827	1877
Hanover	1831	1879
Danzig	1904	1904
Breslau	1905	1905

A certain prescribed preliminary education is necessary to qualify the student for admission to the technical univer-

sities. There are three classes of attendants: the regular student, the so-called "listener" and the guest. Those who wish to enter as regular students must have had a nine-year course of instruction at one of the Gymnasiums, Real-Gymnasium or Ober-Real-Schulen, and must have graduated therefrom by taking the so-called "Abiturienten" examination. This nine-year course cannot be entered upon until after the student has passed through a three- or four-year course in the lower schools, so that if he enters the latter at the age of six, he will be at least nineteen years of age before he enters the technical college, since he must also put in one year at practical training in regular manufacturing plants.

In the Ober-Real-Schulen ancient languages have been entirely eliminated from the course of study and more time is devoted to modern languages, natural sciences and mathematics, the whole course being especially arranged for preparing the student for the technical professions. The majority of these Ober-Real-Schulen are found in Prussia, there being 42 there as against 69 in all Germany. The greater number of these schools are located in the province of Rheinland, the great industrial district.

The practical experience prescribed for these students covers at least one year, for mechanical and electrical engineering, in pattern-shops, foundry and machine-shops. Two years are frequently voluntarily devoted, part of which is spent at construction in the field.

As military service in Germany is compulsory, being generally a two- to three-year service, it might be stated here that those who have graduated from any of the three schools referred to are required to serve only one year in the army. Many students first absolve this military service before entering the technical university. As the regular course in these universities consists of eight semesters (four years) it will be observed that the graduate from the university will have reached the age of at least twenty-four years.

Technical universities confer first the degree "Diplom Ingenieur" (always abbreviated as "Dipl. Ing."). The certi-

ficate of graduation always qualifies the graduate to enter upon a further examination for the degree of "Doctor Ingenieur" (abbreviated as "Dr. Ing."). This degree may also be conferred as an honorary title in recognition of work done in a technical line.

A graduate having the degree "Dipl. Ing.," must if he desires to enter the federal service, give notice thereof to the state within six months after graduation, and, if engaged, after state examination, he is made "Regierungs Bauführer." After being in service for four years he may take a promotion examination for "Regierungs Baumeister," and eventually may reach the top of the service.

The "listener" can only be qualified to enter the German Technical University after graduating from one of the six-year courses in the Pro-Gymnasiums or Real-Schulen. The distinction between Gymnasium and Real-Schule is as follows: To the former belong the Gymnasium, with a nine-year course, and the Pro-Gymnasium with a six-year course. To the second class, or Real-Schulen, belong those in which Latin is included, namely, the Real-Gymnasium and the Real-Pro-Gymnasium. The term in the former is nine years and in the latter, six years. To this group belong also such as include no Latin course, namely, the above named Real-Schule with a nine-year course, and the Real-Schule with a six-year course. The graduate from such schools with a six-year course, need also serve but one year in the army. A preliminary course of three to four years in the lower schools precedes the courses in these six-year or upper schools. This graduate is termed "Einjähriger," with reference to the military service, and the graduate from the nine-year course alone is referred to as the "Abiturient" (one who has made the Abiturienten examination).

"Listeners" may also be those who have graduated from a Technische Mittel-Schule or College, such as the Technicum, Maschinenbau-Schule, Baugewerk-Schule, Kunstgewerbe-Schule, etc. These listeners are usually men of riper age, who have already been engaged in practical work and who

wish to acquire additional knowledge in their special branches of work. They therefore choose but certain lectures, usually extending over from two to three years.

"Guests" are those who have had an academic training, or such other persons who would not be regularly entitled to enter as listeners; but these can only attend a limited number of lectures.

Instruction in these technical universities is in the form of lectures, exercises, shop and laboratory work (upon which much stress is laid), and visitation of manufacturing plants. Large experimental shops and libraries serve as auxiliaries for instruction. For instance, at the Technical University at Darmstadt there is a library of 800,000 volumes, while that of the Berlin Library amounts to far more than one million volumes.

As is the case in all German universities the student may attend the lectures to any extent that he may choose and no roll is called. It is the intention to make of the student an independent thinker. The attendant is supposed to have reached the age of responsibility at the time he enters the university, having passed through the many grades of lower and upper schools, and many having passed through the military service and conformed to the strict regulations of the manufacturing establishments. In all of these strict discipline is the watch-word. The student is allowed to attain his scholarships at as many universities as he desires, thus getting the advantage of the different methods of prominent professors in the different subjects.

The attendance at the eleven German universities for the winter semester, 1907–1908, was 15,720. Of these the listeners and guests amounted to 4,186 and there were 11,534 regular students. It might be of interest to give the number of students who received degrees. During the term 1906–1907, from a total of 15,453 attendants, 1761 received the degree of "Dipl. Ing." and 115 received the degree of "Dr. Ing." During the term 1907–1908 the German universities conferred the honorary degree of "Dr. Ing." upon 738 engi-

neers. Of these, 585 received the degree in recognition of special engineering work performed.

Many students do not take the examination and these receive a certificate of attendance showing the semesters which they attended, as do also the listeners and guests, who are not qualified to take the examination.

In addition to the technical universities there are also numerous other technical institutes, such as Polytechnicum, Technicum, Baugewerk-Schule, Kunstgewerbe-Schule and Maschinenbau-Schule, all of which are classified as technical middle-schools or colleges. The number of these is far greater than that of the technical universities, and admission to them is not so much restricted. The degrees which are obtainable by the students of these colleges are those of mechanical, electrical or mining engineer, etc., and some of these colleges confer the degree of Maschinen-Techniker, Electro-Techniker, etc. There are also a number of minor technical schools, all of which are important factors in making up the present high efficiency and high standard of the industries of modern Germany.

It should always be considered the sacred duty of the promotors of engineering education to instil in the minds of students and to keep before the engineering profession in general the fact that no great headway can be made as long as the belief is prevalent that we know it all and cannot learn from others.

Having discussed the system in vogue in Germany for educating the engineer and fitting him for his profession from both a theoretical and practical standpoint the writer will compare the German and American engineers as to standing as well as to their efforts at seeking further knowledge. To expand his knowledge the German engineer not only serves in a professional way with engineering concerns in Germany, but also gathers experience by so serving with such concerns in foreign countries. The question of salary is, for this reason, not considered by him of first importance. America is usually his Mecca, for he recognizes the fact, impressed

upon him by the German professors, that much information may be gathered there and particularly from American practice. We find this custom encouraged by the government, as well as by the manufacturers and the technical societies. It cannot be emphasized too strongly that the rising German engineer does not refuse to believe that much may be acquired from the methods and practice in foreign countries. For this very reason we find that not only the German manufacturer but also the individual engineer, eagerly subscribes for foreign technical papers which they thoroughly study and for the study of which they are also thoroughly equipped as indicated by their educational training above cited. This stands out boldly as compared with the custom in America, where the engineer rarely peruses a technical paper published in a foreign language. While it is believed here that most literature of importance is translated, it is, nevertheless, a fact that the subjects of greatest importance, particularly where higher theories are treated, are seldom translated into the English language. The reason for this is that few American engineers who are masters of the foreign language care to undertake the task, while foreign engineers do not find it necessary, as they understand the original publication. It is also true that most translations fall short in every respect of being equal in value to the original.

During my ten years of experience and observation in this country, I have found that the American engineer is too apt to take up the first technical work at hand on any special subject and adopt for his work or scheme the ideas or practice suggested therein. It is sometimes claimed that the American engineer is a thorough specialist, but this is not generally true, as he is apt to jump from one line of work to another when there appears to be an inducement in the shape of greater financial gain. In Germany it is with great difficulty that an engineer can take up some other line of work because of the customs prevailing there which must guide his actions. Such proceeding is not looked upon favorably, as he would not be considered as having sufficient practi-

cal experience in the new line, and if attempted it would be at a financial loss for a few years at least. A "jack-of-all trades" is usually supposed to be master of none. Bearing these facts in mind it is quite apparent why we have in this country so many failures in connection with engineering undertakings, such as bridges, dams, locomotives, prime movers and entire industrial undertakings, etc., as compared with the number and magnitude of such failures which occur in Germany.

A fact which is beginning to dawn upon us is that we must look to Germany for originality and economies or efficiency in engineering propositions. In this country a proposition which involves the expenditure of two million dollars for development purposes would not be looked upon favorably. Such a project was the high speed Marienfeld-Zossen line equipped near Berlin some years ago to obtain a speed of 125 miles per hour. German manufacturers, for their mutual interest, similarly united in developing gas engines of large capacity. More recently promoters and manufacturers, with the assistance of the government, united to develop the art of aërial navigation. A great handicap in America is the desire of manufacturers and others who should foster engineering education, to standardize their products for the purpose of greater financial gain. This is undoubtedly a disadvantage so far as the promotion of the engineering profession is concerned. An illustration of the difference between German and American practice is shown by the fact that, during my three-year engagement with one of the leading electrical concerns in Germany, we installed twenty-three electric railway systems, of which eighteen were of different design as to their principal features.

Outside of prominent professors and well-posted literary men there are few engineers who recognize the results directly attributable to the German educational system and industrial methods and it may be well to repeat some opinions based upon an actual study, in Germany, of the conditions existing there.

In an address delivered by Mr. L. B. Stillwell, president of the American Institute of Electrical Engineers, before the Rensselaer Polytechnic Institute in 1909, he states in part as follows:

"The voice of America in this age is one of exaltation. The man in the street believes that we easily lead the world in science and in its practical applications, but those better informed know that we have strong rivals; that, while practice in America in mechanics and the electric art compares favorably, as a whole, with that of any country, the discovery of the facts upon which practice is based has been more often European than American. Even in the practical applications of physical science it happens not infrequently that we follow and do not lead.

"The German Empire to-day is a vast hive of industry organized in a manner of which comparatively few Americans who have not investigated this subject have anything like an adequate conception. In an interesting and very valuable paper upon 'Engineering Education' read before the International Engineering Congress in St. Louis in 1904, Dr. Robt. Fletcher, director of the Thayer School of Civil Engineering, Dartmouth College, said, 'Realizing that even the most industrial people must have competent expert direction and that efficient direction of any industry to-day demands a large amount of technical knowledge which cannot be learned at the bench or in the shop, the government and the people, through trade association have established hundreds of schools of applied science for instruction in all of the leading industries of the empire and often many schools for the same industry.'

"In 1898 Professor J. B. Johnson, M.Am.Soc.C.E., reported that of 248 monotechnic schools in Prussia alone, more than half were voluntarily supported by various trades as schools for apprentices; in Saxony with one million inhabitants there were three monotechnic schools, besides ten schools of agriculture and forty of commerce. In Hesse there were schools for agriculture and sculpture, nine for artisans, forty-three for industries and eighty-two for design.

"German foresight and system in the organization of industrial facilities not less than the industry and the frugality of the German people have advanced Germany within fifty years from a position of comparative poverty and obscurity to a place in the foremost rank of powerful and progressive nations. As Dr. Fletcher well said: 'It is not her army of soldiers which other nations need to fear, but her armies of scientifically-trained directors of industrial enterprises and of highly educated commercial agents.'

"While no other nation to-day provides as effectively as do the Germans for enlargement of the boundaries of science and original research nor for the systematic training of its people in the industrial and commercial use of scientific facts and methods, there is very much that is admirable, effective and worthy of our most careful consideration in the educational, industrial and commercial practice of some of the other great nations."

The standing of the American engineer in his profession and in the community cannot be compared with that of the German engineer in his country and we need not seek very far for an explanation. All education receives proper recognition in Germany and the engineer is placed on a social plane with the doctor, the lawyer, the army officer, etc. His compensation, as compared with that of mere mechanics, is proportionally higher than in this country, so that he is naturally able to occupy a higher plane. The chiefs of departments, as well as the consulting engineers and manufacturers, all work in harmony with the subordinates or assistant engineers, designers, etc., and are not loath to give credit to whom credit is due for any new designs or creations.

The engineers and assistants are all employed under term contracts and the law prescribes what notice must, at least, be given to terminate the employment. This ranges from one to three months. It is a common practice to engage even assistant engineers for terms varying from one to five years, whereas in America the unjust practice prevails of laying off such employees as though they were mechanics or laborers, prac-

tically without notice, and as soon as the important engineering work is completed. One prominent concern is known to have laid off about one hundred men on a Christmas Eve without giving any notice whatever. It is therefore not surprising that a great many well-trained engineers drop their profession at the age of thirty years and enter upon vocations in which they may be assured of greater returns. This necessitates the employment of new and younger men when new propositions are at hand, and such men require again to be trained for their duties. Without further commenting on this situation it shows a lack of foresight on the part of the engineering management. This state of affairs is directly chargeable to the engineering profession itself in neglecting to bring about reforms in the customs and remedying such evils. In Germany the conditions incline the engineer to stick to his post through life and the engineering concerns and manufacturers reap the benefit of his accumulated experience and knowledge.

Written discussion on the above paper, if received before Dec. 1, will, with the approval of the Editing Committee, be printed in the PROCEEDINGS. Contributions should be brief and interesting and should add something to the subject.—Ed.

The following paper was presented at the eighteenth annual meeting, Madison, Wis., June 23, 24, 25, 1910. Written discussion is invited.

NOTES ON THE CO-OPERATIVE SYSTEM.

BY HERMAN SCHNEIDER,

Dean of the Engineering College, University of Cincinnati.

It is difficult to formulate a simple comprehensive statement of the principle underlying the co-operative system. Various attempts have been made to condense it into one sentence, as, for instance, "Hitching the school and shop abreast, rather than in tandem"; "combining theory and practice." In former papers, this statement has been used: "The practical side of engineering, that is, the technique, can be learned only in a shop working under commercial conditions, and the theory underlying the technique can be taught only in a school by skilled teachers." Perhaps the best statement of the fundamental idea is this: "The practice of engineering cannot be learned in a university; it can be learned only where engineering is practiced, namely, in the shop or field. The theory underlying the practice may be obtained outside of the university, but can be best obtained in an organized system of instruction under skilled teachers."

It should not require much argument to show that the practice and the theory underlying it should be taught simultaneously, if possible. As a matter of fact, the whole argument for the co-operative course, together with the investigation which led to it, would make a long and involved statement, and while it might prove more conclusive than any simple expression, we have always felt that the demonstration of the scheme, together with a statement of the results achieved year by year, would be more effective. While we still believe the actual demonstration to be better than the argument, we find that many erroneous impressions prevail concerning our work.

Curiously enough, many people think that the basic idea in the co-operative system is the alternate-week arrangement. The plan by which theory and practice are combined and co-ordinated is merely a detail and the alternate-week scheme which we use is the one which happens to fit our local conditions the best. Even in our own school we are devising different systems of co-operation.

For instance, after four years of experiment we have decided to operate the co-operative courses in electrical, mechanical and metallurgical engineering on the alternate-week plan eleven months in the year, reducing the length of the courses from six years to five years.

In civil engineering, we have the alternate-week scheme eight months in the year, and for the summer months we have made an arrangement with the Union Pacific Railroad Company, whereby our students obtain field work in railroading, together with instruction given by the railroad company. In chemical engineering there will be a marked departure, according to our present plans from both of these details of operation.

It must be evident that for different localities, different means of getting theory and practice together will be used, and, also, in different courses the ratio of theory to practice will vary. For example, the University of Wisconsin probably could not operate on the alternate-week plan because of its distance from the factories of the state. It could establish a faculty in Milwaukee and have an alternate week or fortnight scheme; but if the faculty remained in Madison the plan would probably be to have eight months of instruction at Madison and four months of scheduled shop work with co-ordination in Milwaukee, using four rotating sections so that the shops would always have the same quota of student apprentices. Such a plan as this would be a co-operative scheme, of course, but would have a less amount of shop work, and in the opinion of some of our critics, would be a more beneficial arrangement than the one which we believe to be the best for our conditions in Cincinnati.

Further, in co-operative law, medical, commercial, agricultural, architectural or mining courses, it is evident that the amount and character of practice would vary greatly. I believe, and sincerely hope that there will be many forms of the co-operative system adopted by different institutions and out of all of these we shall probably get, by experiment, the best forms. I can readily see that some of the more conservative eastern institutions will hesitate to tie up as intimately with commercial shops as we have done in Cincinnati. It is probable that they will adopt some form of the co-operative system with a less amount of outside practical work, making the work less rigorous, and devising their details so as to cause the least amount of disturbance to their present systems. Four years of experience in operating our co-operative courses, however, leads me to expect failure for any co-operative scheme which is not made commercially profitable for the shops, which does not start the student at the very bottom of the practice of engineering, which eliminates the hard work that the regular mechanics do or the regular hours they maintain, or which modifies the shop discipline simply because the apprentices are university students. Any attempt to evade the disciplinary conditions which have through the ages made strong men, while it may be an advance on the old four-year system, will not meet the expectations of its sponsors.

These thoughts are born of the questions so frequently asked us by college teachers not situated in industrial centers and by others who are in factory communities, but who have a vague fear that somehow the standard of their scholastic work, their dignity and their independence will be jeopardized by contact with the wicked world.

Opposition to Physical Work.

It is astonishing how much opposition there is to that part of our system which requires a student to do the hard physical work of laborers and mechanics. Engineering professors, particularly, and in some cases practicing graduates from

four-year courses, seem to feel strongly that the high plane upon which the engineering profession is supposed to be, is in danger of being let down a peg, if embryo engineers begin their careers as apprentices. I have never been able to get a crystallized, logical statement of these objections. Personally, I believe that a goodly amount of physical work in contact with those whose lot it is to labor should be required of every young man in his formative years, no matter what his position in life is, or is to be. Especially should it be required of future engineers. Strong men have always grown stronger and better through this contact and competition, and the weaker ones find their levels more quickly than in any other way.

Why an engineering college should not adopt nature's rigorous methods of finding leaders is not evident, and if engineering education should be for any particular purpose, it should certainly be for the training of leaders in production and construction. Surely, a youth approaching manhood who does not feel within him the craving to measure his strength of body and mind with those who do the day's work lacks certain qualities necessary for leadership; and should not, therefore, get the training intended for leadership. And if he does have the craving, let him satisfy it; let him grow naturally, guide his growth, and supplement it with proper intellectual instruction.

In our opinion, the man who has not the will and willingness to do physical labor in the practical engineering world is not a promising candidate for the engineering school; nor do we believe that imitation work in imitation shops should be offered to the students as an equally good, but easier and more dignified substitute for the character-building, man-making real work of real shops. Indeed, there is a sort of academic snobbishness, most unwholesome for the students, and most undemocratic in its essence, which looks askance at all knowledge that does not come by the book, and which feels that between the practical and the intellectual there is a great gulf fixed.

The Business of Training Engineers.

Now I assume that we are in the business of training men for the practice of engineering; and I further take it that the practice of engineering means the economical use of the forces and resources of nature for the benefit of mankind. The day has come when we must place honest emphasis on the word "economical"; we must also remember that mankind means all men, the majority of whom are those who produce and construct in using the resources of nature. We are, in fact, servants of each other, and in this mutual but complex interdependence of production, we have for some time been leading surely to a crisis, which grows more acute as the nation becomes more industrial, and which will necessitate the solution of two problems: First, the elimination of waste in production, and secondly, the scientific use of labor to the end that it may be most efficient, best rewarded and properly conserved. These are matters not for the lawyer and politician, but for the engineer. That day is passing when the magnificent waste of men and materials can be an ignored consequence of achievement.

The integration of a multitude of shop errors between the limits of January 1 and December 31 is now as much an engineering problem as the most delicate deduction in calculus. The training necessary to find all the factors which enter into this integral equation is just as much a part of engineering education as is mathematics. A working knowledge of the toxins of fatigue is as important, to say the least, as an ability to discover and eliminate the impurities in castings. To conserve the years of labor is as much a part of economical engineering as to find a good preservative coating for bridges. A knowledge of the limitations, the weakness, the group subleties of men, is as requisite as a similar knowledge of materials.

If we are to have a saving solution of this broad engineering problem of conservation in production, the men who tackle it must be initially aggressive in spirit and keen of mind; they must be deeply versed in science; they must have a thorough

and intimate knowledge of men and materials; their instruction in the humanities must give them breadth of vision, and the resultant breadth of tolerance; and they must know the real problem as it is.

The Reflex Action on the University.

In joining with producing and constructing concerns to train young men for this type of engineering activity, we anticipated that there would be a reflex action on the engineering college. The reaction was not slow in coming. It was more in the nature of a flareback. My telephone was very busy that first half year: "That cub you sent down here," the voice would say, "thinks this is a university. He won't work." It did not take us long to learn that it was necessary to paint the shop end of the course to aspiring Edisons in broad, black, greasy, sweaty strokes. One after another, young men came to inquire about the work and one after another they would surrender to their mental aversion for early hours and much grime. But there was a fine residue from the sifting, a residue that meant business. Each year our list of applicants has grown and the selection has been more and more rigid; as a result, our losses during the summer tryout decreased as the following table indicates:

Losses During Summer Trial Period in Per Cent.

Year.	
1906	40.0
1907	28.4
1908	13.6
1909	8.1

We also learned that first year, and have had it verified each year since, that the shop will spot a yellow streak in a man before the university even suspects it. An attempt to sneak spoiled work through is never a great success. It is not even a commendable failure, and the rest of the workmen view it with tersely expressed disgust. It requires only a few days for a young man to realize that he must stand squarely

on his own merits and that most of the men in overalls about him are a peculiarly keen lot of men worth cultivating. And this is when young Edison begins his combination course in tact and integrity.

We at the college end soon found our work under a scrutiny and criticism, with final judgment suspended, and this too from a source which does not hesitate to scrutinize and criticize. We are brought face to face with the failure of a university department as we never are in our four-year courses. A student, let us say, has finished successfully his work in physics; some day he does a fool thing in the shop which indicates that he knows very little about the subject. When you confront him with the fool thing and with the fact that he should have known better because he had been taught the theory governing it, you find his grasp on the theory to be very feeble. It is not a part of his working organism.

The Co-ordination of Courses.

Experiences of this sort caused a serious introspection on the part of our teachers, and a consequent readjustment of our courses and methods. We soon found that much of our trouble resulted from a lack of co-ordination between courses. After trying various plans to remedy this, we now have a system whereby each course is charted in a circle clockwise by weeks. At the periphery of the circle are the names of the teachers who tie to the particular work of any week. Every teachers gets a copy of every course chart. The instructor in charge of the course is chairman of a committee on that course, the other members being those whose work correlates with his. In this way a number of men may teach a subject which was formerly taught by one man. For example, the professor of metallurgy enters the bridge-design and testing-laboratory courses at appropriate times; the professor of industrial chemistry gives part of the course in cement.

Our experience also taught us that it was necessary to have a separate set of men to co-ordinate the work of the shop with the work of the university. A department was started to do

this, and men were appointed of the grade of assistant professor and with the title of co-ordinator. The shop co-ordinator is a college graduate acquainted with shop practice. He spends every morning at the university and every afternoon in the shops. His function is to make a direct weekly co-ordination of the work of the shop with the theory of the university. One afternoon, for example, he may be at the shops of a local manufacturing company, where he will observe the student apprentices at work. He will know what they are turning out, their speeds, their feeds and cuts, the angle of the tool, how the batch of work is ticketed, how the work is set up, the power drive, everything important in connection with the operation.

The next week these young men will be grouped together with their classmates for two periods in class, when he will explain the functions of the particular articles on which the students were working, in the machine which the local manufacturing company builds. He will take up all questions of speeds, feeds, cuts, accuracy, etc. Figuratively speaking, he will take from the student apprentices the blinders which would restrict their vision except for this explanatory work. The ticketing of the batch of work is gone into, and the system of shop routing is explained. Ultimately all problems of shop organization, shop accounting, cost keeping, shop planning, power transmission, heating, lighting, etc., are discussed during the course.

In conjunction with this, a card system is employed by means of which everything the student does in the shop that exemplifies a theory taught in the university, is called in detail to the attention of the teacher of theory, so that when the student comes to that particular theory, the exemplifications which he has had in his practical work in the shop are called to his attention. It will be seen, then, that out of the student's own experience is drawn much of his course in mechanism, thermodynamics, machine design, strength of materials, shop economics, etc.

This system has been in operation for one year, and is one of

the most valuable additions we have made to the scheme. The co-ordinators have made a careful study of each shop, and are now completing organization charts showing the path which a student can most profitably follow through the shop. In addition to the shop chart, a chart is made for every individual student which indicates how closely this path has been followed, and why there have been deviations, if any. These charts are the result of four years of closely observed experiment on the part of the university and the shops, and have been worked out by conferences between shop co-ordinators and shop superintendents.

The Scientific Spirit Is Not Killed.

Our critics have always felt that the amount of work given would tend to kill the scientific spirit, and to instill a too practical one. A recent occurrence worth mentioning in this connection, was a meeting of all the co-operative students with the faculty to discuss the five-year, eleven-month plan of operation. At this meeting the students who have been with us three or four years strongly expressed the hope that the course would be made six years long, eleven months of the year. None of the students wanted a six-year course, nine months of the year.

When the vote was finally taken, it was found that all the men who had had three or four years of the work wanted a six-year course, eleven months of the year, while the younger men were unanimously in favor of a five-year course, eleven months of the year. The reason given for their attitude by the older co-operative students was that they wanted to take up in the university, advanced scientific work of a post-graduate grade, together with certain academic subjects such as psychology and logic, and that they desired also to take a more comprehensive group of technical subjects than is usually given in any engineering course. That is to say, they have become so impressed in the shop with the broader aspects of engineering, that they desire to touch not only the technical subjects of their own courses, but also many of the technical subjects of other engineering courses.

As a result, courses will be arranged so that men, on graduating after five years, will be enabled to take one or two additional years if they so desire. This attitude was not surprising to those of the faculty who were watching the development of the co-operative students. A curious, and, I think, entirely unusual situation was developed in the meeting, when nearly every speaker on the students' side solemnly warned the faculty that no measures should be taken which would in any way endanger the high standard of the co-operative course in the university.

Of course, our experience in four years of operation has enabled us to determine in advance that the usual work of the four-year theoretical course could be carried on by co-operative students in five years of half-time work eleven months of the year, even though the standard maintained in the co-operative work is much higher than that of the four-year courses. A student's rating, by the way, is not determined by examination, but by a record of daily efficiency. We have abolished examinations, but pay very close attention in the weekly faculty meetings to the weekly records of our co-operative students. Short written tests are given frequently, and without advanced notice. A certain pace is set and if the student cannot or will not maintain it, he is dropped from the course.

Teaching How to Tackle a Problem.

We are more and more convinced that the best thing a university can teach an engineering student, is how to tackle a problem, and to this end most of our summer work is devised. All of the summer work in the university is to be constructive, following the analytical work of the previous year's theory. For example, the student's first problem will be something like this: "There is a barrel of rock salt; you are supposed to have a certain knowledge of theoretical chemistry after your year's work. Here is the laboratory; here, also are the necessary industrial implements; over there is the library. Now go and make four pounds of table salt. At

five o'clock each day let us have a written report on what you have accomplished."

Following this and other simple problems, the work becomes more complex, leading into boiler compounds and metallurgy. The student will be compelled to rely almost entirely on his own resources, except for critical suggestions following errors, and by the time he has reached his third summer, it is hoped that he will be able to use the laboratory, the library and his theoretical knowledge to make a logical and effective attack on a new piece of constructive work. In his last year he will have several problems which will involve theoretical considerations that he has never met, except, perhaps, in the fundamentals of physics.

Many additional changes in curriculum and method are in process of development, looking to a more rigorous mental and physical training of our young men for work in production and construction. And though a few of our students upon graduation will become teachers of future co-operative students, and a few more, temperamentally fitted for work in pure science, will join the freemasonry of those who explore beyond the ranges of the known, the majority will continue in the more prosaic business of helping to do the world's work. And these will bring to their tasks a working knowledge of the many-sided life of the shop and field, coupled with an ability to apply to it the rapidly increasing fund of material which the pure scientists uncover, to the end that the yield may be greater and the spirit of the labor brighter. And this, I take it, is engineering.

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